

## CLAIMS

### We Claim

- 5 1. A carbon dioxide recovery process for supercritical extraction comprising:  
providing a process stream from a supercritical extraction procedure wherein  
the process stream includes pressurized carbon dioxide, extraction process waste and  
optionally at least one co-solvent;  
reducing the pressure of the process stream below critical pressure;  
10 venting low pressure carbon dioxide vapor to exhaust;  
cooling the process stream to form a two phase mixture;  
separating the two phase mixture into a process liquid, containing co-solvent  
if present, and a process vapor phase stream;  
collecting the process liquid;  
15 filtering the process vapor phase stream to remove particulates and  
optionally residual co-solvent;  
passing the filtered process vapor stream through an adsorber to remove trace  
impurities to form a purified carbon dioxide vapor stream; and,  
drying the purified carbon dioxide vapor stream to remove residual water  
20 vapor.
2. The process of claim 1 further comprising:  
optionally supplementing the dried, purified carbon dioxide vapor stream  
with a distilled carbon dioxide vapor stream to form a feed carbon dioxide vapor  
25 stream;  
filtering the feed carbon dioxide vapor stream to remove condensable vapors  
and particulates; and,  
cooling the filtered feed carbon dioxide stream to form an intermediate  
carbon dioxide liquid stream.  
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3. The process of claim 2 further comprising:  
filtering the intermediate carbon dioxide liquid stream; and  
pressurizing the intermediate carbon dioxide liquid stream.

4. The process of claim 3 further comprising forming a supercritical fluid from the pressurized carbon dioxide liquid stream and delivering the supercritical fluid to the extraction procedure.
5. The process of claim 1 wherein the adsorber is a plurality of adsorber beds, further comprising isolating at least one adsorber bed and flushing the isolated adsorber bed with vaporized refrigerant from at least one condenser.
6. A process for carbon dioxide supercritical extraction and recovery comprising:
- distilling a feed stream comprising carbon dioxide vapor off of a liquid carbon dioxide supply;
  - filtering the feed carbon dioxide vapor stream to remove condensable vapors and particulates;
  - cooling the filtered feed carbon dioxide stream to form an intermediate carbon dioxide liquid stream;
  - filtering the intermediate carbon dioxide liquid stream;
  - pressurizing the intermediate carbon dioxide liquid stream;
  - forming a supercritical fluid from the pressurized carbon dioxide liquid stream and delivering the supercritical fluid and optionally a co-solvent for a supercritical extraction procedure;
  - obtaining a process stream from the supercritical extraction procedure wherein the process stream includes pressurized carbon dioxide, extraction process waste and optionally at least one co-solvent;
  - reducing the pressure of the process stream below critical pressure;
  - venting low pressure carbon dioxide vapor to exhaust;
  - cooling the process stream to form a two phase mixture;
  - separating the two phase mixture into a process liquid, containing co-solvent if present, and a process vapor phase stream;
  - collecting the process liquid;
  - filtering the process vapor phase stream to remove particulates and optionally residual co-solvent;
  - passing the filtered process vapor stream through an adsorber to remove trace impurities to form a purified carbon dioxide vapor stream;

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drying the purified carbon dioxide vapor stream to remove residual water vapor; and,

optionally supplementing the dried, purified carbon dioxide vapor stream with additional distilled carbon dioxide vapor.

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7. An apparatus for the recovery of carbon dioxide from a supercritical extraction process producing a process stream comprising pressurized liquid carbon dioxide, extraction process waste and optionally at least one co-solvent, comprising means for reducing the pressure of the liquid carbon dioxide; and a vent for passing  
10 low pressure carbon dioxide vapor resulting from the pressure reduction to exhaust; characterized by further comprising:

a separator for forming the process stream into two phases comprising a process liquid, containing co-solvent if present, and a process vapor phase stream;

a container for collecting the process liquid;

15 at least one filter to remove particulates and optionally residual co-solvent from the process vapor phase stream;

an adsorber to remove trace impurities from the filtered process vapor stream to form a purified carbon dioxide vapor stream;

20 at least one dryer to remove residual water vapor from the purified carbon dioxide vapor stream;

a flow network having conduits connecting the components of the apparatus;

the conduits of the flow network including a connection between the at least one dryer and a condenser associated with a supply of carbon dioxide to the extraction process; and,

25 the flow network having valves associated with said conduits to allow for isolation of components of the apparatus.

8. The apparatus of claim 7 wherein the separator is a second condenser for cooling the process stream to form the two phases.

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9. The apparatus of claim 7, wherein the adsorber is a plurality of adsorber beds.

10. The apparatus of claim 7, wherein at least one condenser includes an external refrigeration circuit having a heat exchanger to condense the purified carbon dioxide vapor feed stream through indirect heat exchange with a refrigerant stream.
- 5 11. The apparatus of claim 10 wherein a conduit is provided between the refrigeration circuit and the adsorber to permit used refrigerant to flush out at least one adsorber bed when isolated from the apparatus.
12. An apparatus for the supply and recovery of carbon dioxide for a  
10 supercritical extraction process comprising:  
a bulk liquid carbon dioxide supply tank for distilling off a feed stream comprising carbon dioxide vapor;  
at least one purifying filter to remove condensable vapors and particulates from the carbon dioxide vapor feed stream;  
15 a first condenser for condensing the carbon dioxide vapor feed stream into an intermediate liquid carbon dioxide stream;  
a low pressure accumulation vessel for accumulating the intermediate liquid carbon dioxide stream;  
at least one particle filter to remove particulates from the intermediate liquid  
20 carbon dioxide stream;  
means for pressurizing the intermediate liquid carbon dioxide stream to form a pressurized liquid carbon dioxide stream;  
a high-pressure accumulation vessel for accepting the pressurized liquid carbon dioxide stream;  
25 a supercritical extraction apparatus for receiving the pressurized liquid carbon dioxide stream and optionally a co-solvent, for carrying out the supercritical extraction and providing a process stream comprising pressurized liquid carbon dioxide, extraction process waste and optionally the at least one co-solvent;  
means for reducing the pressure of the liquid carbon dioxide;  
30 a vent for passing low pressure carbon dioxide vapor resulting from the pressure reduction to exhaust;  
a separator for forming the process stream into two phases comprising a process liquid, containing co-solvent if present, and a process vapor phase stream;  
a container for collecting the process liquid;

at least one filter to remove particulates and optionally residual co-solvent from the process vapor phase stream;

an adsorber to remove trace impurities from the filtered process vapor stream to form a purified carbon dioxide vapor stream;

5 at least one dryer to remove residual water vapor from the purified carbon dioxide vapor stream;

a flow network having conduits connecting the components of the apparatus;

the conduits of said flow network including a vapor vent line from the low pressure accumulation vessel to the condenser to facilitate introduction of the  
10 intermediate liquid carbon dioxide stream into the low pressure accumulation vessel;

the conduits of the flow network including a connection between the at least one dryer and the at least one purifying filter upstream from the first condenser; and,

the flow network having valves associated with said conduits to allow for isolation of components of the apparatus.

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13. The apparatus of claim 12 wherein the separator is a second condenser for cooling the process stream to form the two phases.

14. The apparatus of claim 7, wherein the adsorber is a plurality of adsorber  
20 beds.

15. The apparatus of claim 12, wherein at least one condenser includes an external refrigeration circuit having a heat exchanger to condense the vapor feed stream through indirect heat exchange with a refrigerant stream.

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16. The apparatus of claim 15 wherein a conduit is provided between the refrigeration circuit and the adsorber to permit used refrigerant to flush out at least one adsorber bed when isolated from the apparatus.

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